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B60T 8/17; B60T 8/32; B60T 7/00
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340/426.32; 303/89
See application file for complete search history.

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Primary Examiner — Tan Q Nguyen

(74) *Attorney, Agent, or Firm* — Kenyon & Kenyon LLP

(57) **ABSTRACT**

A trailer electronic braking system includes a braking device capable of generating a braking force on a wheel on the trailer, a brake force into the brake cylinders being controllable by a braking ECU. The braking ECU is connected to a standards compliant communication bus on said trailer and is adapted to receive data inputs from sensors on the trailer. An interface to trailer electronics and a communications interface are also provided. The brake system is further adapted to transmit a trailer identifier such as an SSID, such that the trailer identifier can be paired with a further device, such as a mobile telephone associated with a tractor driver, the further device having previously been provided with the trailer identifier.

6 Claims, 3 Drawing Sheets

- (51) **Int. Cl.** 2010/0188203 A1 7/2010 Wallace et al.
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B60T 13/66 (2006.01) 2010/0222979 A1 9/2010 Culbert et al.
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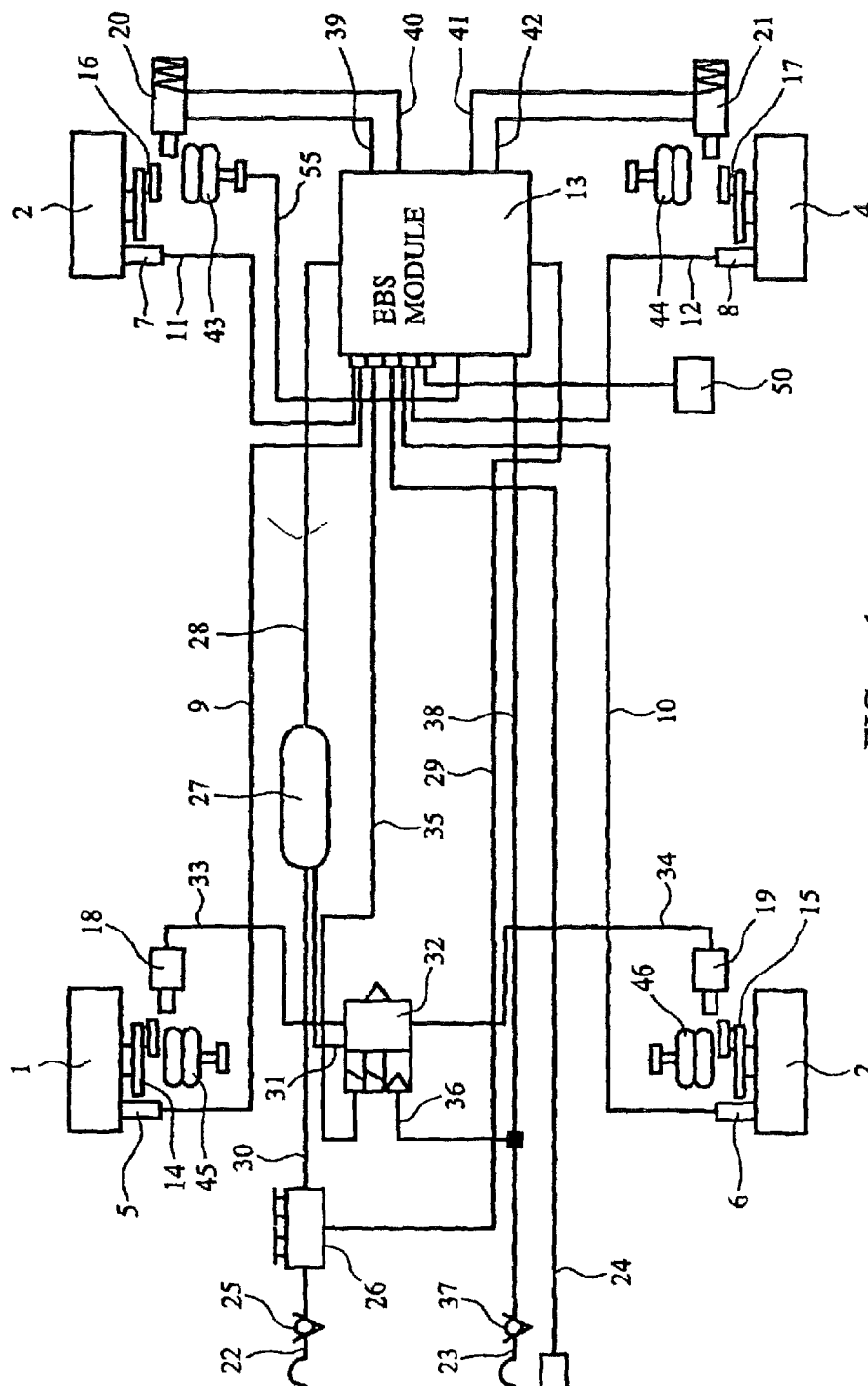


FIG. 1

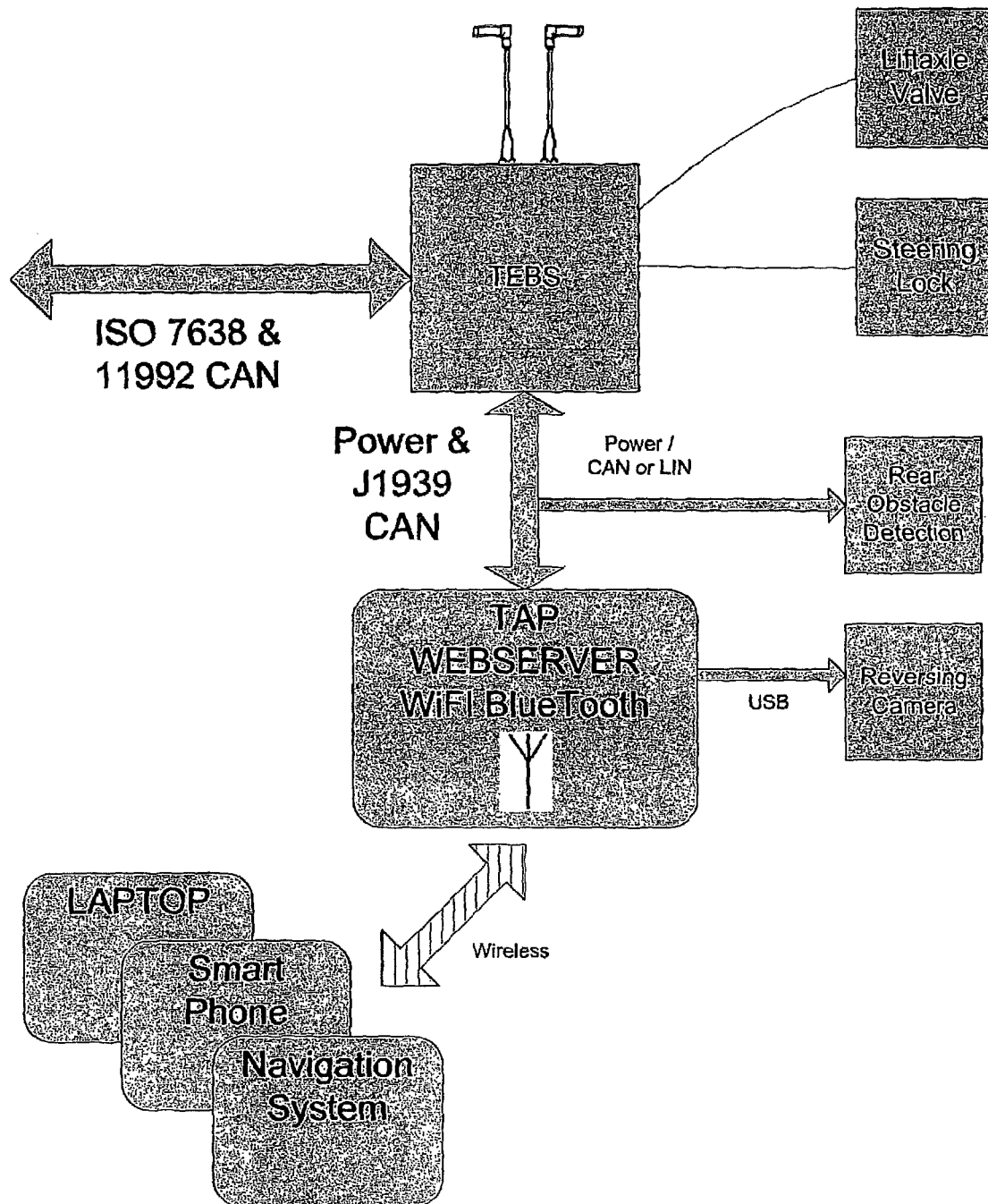


Figure 2

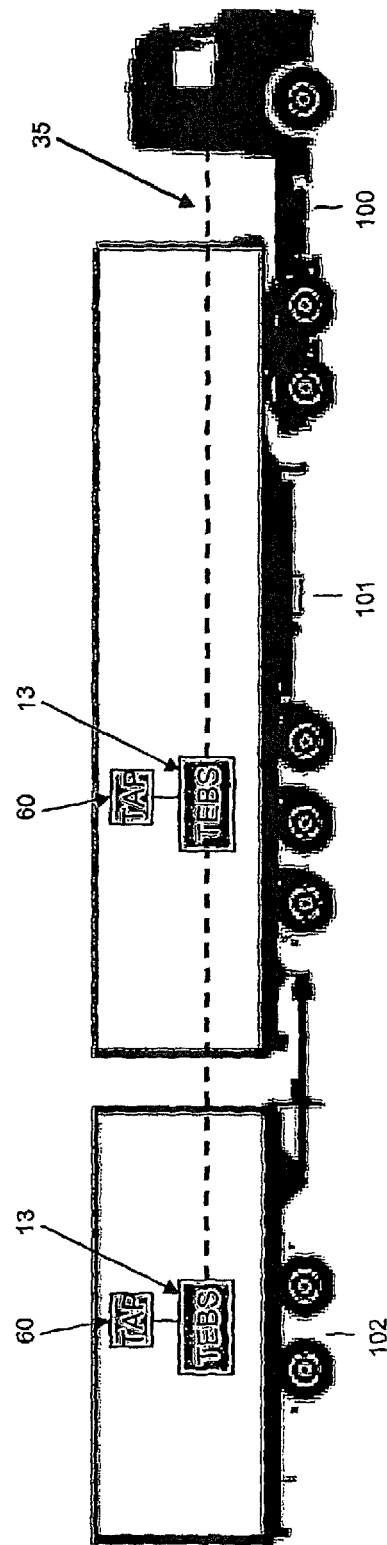


Figure 3

TRAILER ACCESS POINT PAIRING**FIELD OF THE INVENTION**

The present invention relates to a trailer electronic braking system.

BACKGROUND INFORMATION

The trend in modern distribution systems is towards having large distribution depots located on the outskirts of towns and cities near main trunk roads. These large distribution depots have a number of significant logistical advantages for the operators in terms of stock control and speed and ease of distribution of goods. However, depots have become larger with many having dozens or even hundreds of trailers on site and allocated a job at any one time. In particular for larger companies, it has become difficult to track the trailer use in the depot due to the sheer number of trailers and due to the use of standardized trailers having identical appearance.

Furthermore, trailers for many goods are loaded and then moved from a known loading bay to a parking area to await a tractor or prime mover to take it to its destination. Trailers used in this environment will be assigned a trailer number or identifier. To reduce the risk that a driver takes the wrong trailer, there is usually an independent manual check at the exit gate that the driver has taken the correct trailer.

Patent document WO 2005/115811 discusses an anti-theft system for a trailer comprising an immobiliser which is adapted to communicate with an identified mobile telephone.

This system has given rise to significant logistical efficiencies but is still prone to human error and has a high degree of manual input. This slows down the operation of the trailer depot and results in additional costs for operators due to the inefficient use of resources.

SUMMARY OF THE INVENTION

The present invention seeks to provide apparatus to assist depot operators in the optimization of the use of trailers.

According to the present invention there is provided a trailer electronic braking system comprising a braking device capable of generating a braking force on a wheel on the trailer, a brake force into the brake cylinders being controllable by a braking ECU, which braking ECU is connected to a standards compliant communication bus on said trailer and is adapted to receive data inputs from sensors on the trailer, wherein the system further comprises an arrangement to interface to trailer electronics and a communications interface, wherein the brake system is further adapted to transmit a trailer identifier, such that the trailer identifier can be paired with a further device, which further device has previously been provided with the trailer identifier.

The further device may be a mobile telephone used by the intended driver of a tractor associated with the trailer or alternatively a navigation system on the tractor. The trailer could also be associated with a further trailer in a road train.

The communication interface may comprise a 802.11 wireless interface, which interface is adapted to transmit an SSID, the trailer identifier comprising the SSID.

The trailer electronic braking system may be provided with a list of MAC addresses associated with allowable further devices, the braking system detecting the MAC address of any further devices it detects such that it only pairs with an allowable Mac address.

The further device may be provided with parking brake releases codes, which codes can be transmitted to the braking ECU after pairing to thereby release the parking brake.

In a road train, the road train may comprise two or more trailers, at least two of which trailers are adapted to transmit a trailer identifier, wherein a first trailer for connection to a tractor or prime mover is adapted to request or detect the trailer identifier of another trailer, wherein if the trailer identifier is associated with the road train, the first trailer instructs the second trailer to stop transmitting its trailer identifier.

The system of the present invention advantageously speeds up the pairing of a tractor and a trailer compared to the existing manual solutions.

The trailer access point may be provided with an SSID, which SSID is equal to or comprises at least one of the trailer identifier and vehicle identification number (VIN).

In this embodiment, the present invention advantageously permits the adoption of this system in very large trailer depots, where there may be hundreds of trailers and hundreds of wireless systems, which would otherwise become confusing for the driver and operator.

The pairing information may be sent by SMS or e-mail to the driver. The SMS or e-mail may include codes to release the parking brake on the trailer. Alternatively, it would be possible to pair the trailer and tractor using a barcode or 2D barcode, which is readable using a smartphone or similar device. The required barcode could be sent to the smartphone and matched.

Exemplary embodiments of the present invention will now be described in greater detail with reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a trailer electronic braking system.

FIG. 2 shows a schematic diagram of the brake control with a trailer access microcontroller.

FIG. 3 shows schematically a road train.

DETAILED DESCRIPTION

The utility vehicle trailer has a steerable front axle with front wheels 1, 2 and a rear axle with rear wheels 3, 4. Rotational wheel speed sensors 5-8 are in each case assigned to the front wheels 1, 2 and the rear wheels 3, 4, and are connected by way of electric lines 9-12 with an electropneumatic brake pressure control module 13 (EBS module) which is primarily assigned to the rear axle brakes. One brake 14-17 is in each case assigned to the front wheels 1, 2 and the rear wheels 3, 4, which brake 14-17 can be applied by brake cylinders 18, 19 of the front axle or spring-loaded brake cylinders 20, 21 of the rear axle.

The braking system of the trailer vehicle can be connected by way of three connections, specifically a pneumatic supply line connection 22, a pneumatic control line connection 23 and an electric control connection 24, with the braking system of a tractor or a further trailer. The electric control line 24 provides the ISO 11992 CAN data connection.

The supply line connection 22 is connected by way of a filter valve 25 and a parking valve 26 with an air brake reservoir 27. From the air brake reservoir 27, a pneumatic line 28, 30 leads to a supply input of the pressure control module 13 and electropneumatic valve 32, which is adapted to supply ABS functionality. In addition, a pneumatic line 29 branches off the parking valve 26 to the pressure control module 13. A pneumatic line 30 extends between the parking valve 26 and the air brake reservoir 27.

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The electropneumatic valve **32** is assigned jointly to both brake cylinders **18, 19** of the front axle and is connected with the brake cylinder **18** by way of a pneumatic line **33** and with the brake cylinder **19** by way of a pneumatic line **34**. The valve **32** has two electric control inputs which are connected by way of "one" electric communication line **35** such as CAN, shown here only schematically, with the pressure control module **13**.

Furthermore, the valve **32** has a pneumatic control input **36** which is connected by way of a filter valve **37** with the pneumatic control connection **23**. The pneumatic control input **36** is also connected by way of a pneumatic control line **38** with a pneumatic control input of the pressure control module **13**. The pressure control module **13** has an integrated pressure sensor (not shown) which measures the pressure in the pneumatic control line **38**, that is, the control pressure present at the pneumatic control input **36** of the electropneumatic valve, which control pressure is identical to the maximal pressure which can be controlled into the brake cylinders **18, 19**.

The pressure control module **13** has pneumatic outputs **39-42** which are connected by way of assigned pneumatic lines with the spring brake cylinders **20** or **21**.

Furthermore, air bellows **43, 44** are provided at the rear axle and permit a determination of the axle load, particularly of the dynamic axle load during braking and starting. The air bellows **43, 44** are connected by way of pneumatic lines with the pressure control module **13**. The pressure control module **13** has an integrated pressure sensor (not shown) which measures the pressure in the air bellows **43, 44**. Correspondingly the pressure in airbags **45, 46** provided at the front axle, which here are electrically controlled, may be detected by an optional pressure transducer.

To provide stability control a lateral acceleration sensor is provided, which may also be integrated with a yaw sensor, and the output of the lateral acceleration sensor is fed to the pressure control module/ECU **13**. Typically the lateral acceleration sensor is integrated into the pressure control module/ECU **13**. In the event that lateral acceleration on the trailer is detected, the pressure control module can provide for increased brake force at the front and/or rear axles. When the lateral acceleration sensor detects lateral acceleration on the trailer in which it is installed, the sensor generates a signal setting the stability control to active.

The pressure control module **13** receives data from the wheel speed sensors on the trailer and also receives a signal indicating whether the brake pedal in the vehicle cab is depressed or not, as well as the brake pressure demand.

FIG. 2 shows schematically the arrangement of the trailer access microcontroller with the trailer electronic braking system. The trailer electronic braking system is only partially illustrated for reasons of clarity but includes the pressure control module **13** which is shown receiving wheel speed signals from wheel speed sensors **5, 6**. The pressure control module **13** also receives inputs from the lift axles showing the position of the lift axles and also the steering lock. The pressure control module **13** also receives power and data via an electrical connection from the tractor and is also attached to an ISO 11992 CAN databus.

A trailer access point (TAP) comprising microcontroller **60** with a CAN interface is also provided, which is powered from the electrical connection. The microcontroller **60** itself comprises an interface to the on-board electronic systems and the trailer electronic braking system and an interface for sending and receiving data in a wireless format **61**. The communications interface **61** can comprise one or more of a 802.11 transceiver or Bluetooth transceiver or radio transceiver. The

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trailer access point is connected to the CAN bus on the trailer and so is able to receive data from other devices on the CAN bus. The trailer access point can further be provided with USB ports, which enables the addition of peripheral devices on the trailer. An exemplary device on the CAN bus is the rear obstacle detector **62** and an exemplary device attached to the USB port is a reversing camera. USB may be used in this case as the camera would generate large amounts of data compared to the remaining data on the CAN bus.

The trailer access point can be mounted in a housing similar to that used for a trailer information module but without a display being necessary. If a display is needed, it would be possible to use a bistable cholestatic display or zero power LCD display.

In use, when the trailer access point is powered, the provision of the access point enables the data from the devices to be read by another device with a client browser. Such devices could include a tractor navigation system or a smartphone. It would also be possible to use a laptop. The present invention enables the data to be made available to the driver during normal operation as well as to a service technician for maintenance purposes at low cost using standard devices.

The trailer access point can be mounted in a housing similar to that used for a trailer information module but without a display being necessary. If a display is needed, it would be possible to use a bistable cholestatic display or zero power LCD display.

The trailer access point comprises the microcontroller with an interface to the on-board electronic systems and the trailer electronic braking system and an interface for sending and receiving data in a wireless format; the microcontroller is adapted to operate with an optional display as described above and also with the onboard diagnostics. The trailer access point is also provided with USB ports, which facilitate the use of peripheral devices at low cost such as a webcam. A webcam could therefore be used as a reversing camera or it would be possible to use an internal webcam inside the trailer body. An internal webcam is attractive as it would enable free cargo space to be estimated by the driver or operator and would also help prevent thefts or stowaways. It would be possible if the trailer has sufficient communication bandwidth available to continuously monitor the contents of a trailer. It would also be possible to attach a number of devices to the CAN bus. Exemplary devices include door status or obstacle detection sensors or environment sensors.

In use, when the trailer access point is powered, the provision of the trailer access point enables the data from the devices to be read by another device with a client browser. Such devices could include a tractor navigation system or a smartphone. It would also be possible to use a laptop.

Each trailer is provided with a vehicle identification number (VIN), which is usually provided on a plate on the side of the trailer. These plates are also often provided with a barcode or other machine readable data recording the same information. The wireless communication card on the trailer access microcontroller is provided with its own identifier such as the service set identifier or SSID for an 802.11 card. The SSID can also be set to be the same as or include the trailer VIN. The depot operator or truck driver is then provided with a device such as a smartphone so that the handheld device can be used to pair with the microcontroller and hence trailer with the truck. If the truck is provided with a navigation system, it may be used. To provide some additional security, the trailer access microcontroller is provided with a list of allowed MAC addresses with which it is permitted to pair. Pairing in this context refers to the two devices establishing a relationship using a shared secret such as a link key so that they can

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identify one another. Once the communication is established between the two devices they are in effect bonded until the communication is broken.

FIG. 3 shows a further embodiment for use in a road train. A road train consists of a tractor or prime mover **100** and two or more trailers **101**, **102**. Each trailer is provided with an electronic brake control unit **13** and a trailer access microcontroller **60**. This situation gives rise to several new problems. The trailer access microcontroller will not have external antennae and so will not transmit over long distances—some road trains can be 100 m long.

It is possible depending on the technology used in the wireless communications of the trailer access microcontroller that the signal from the microcontroller **60'** of the second trailer **102** is too weak to be seen by the truck **100**. However, if the signal strength is higher, then it is likely to be confusing in a depot as there will be a significant number of trailers providing signals that can be detected by the truck **100**. In this case, the IDs of the respective trailers should be set to be the same.

This problem can be solved. The first trailer **101** will know that it is connected to the tractor **100** as it will receive a corresponding signal via the ISO 11992 connection. The microcontroller **60** of the first trailer **101** then requests the ID or VIN from the surrounding trailers. Where the trailer access microcontroller detects that the ID is the same as its own ID, then it transmits a signal to that microcontroller **60'** to instruct that the second trailer **102** stops transmitting an ID. For multi-trailer road trains, this can be repeated down the train.

Although the trailer access point has been specifically described as a microcontroller, it would be possible to incorporate the functionality as an auxiliary function in the trailer electronic brake control unit. The trailer electronic brake control unit receives the operational data from the sensor outputs but would need to have an additional communication interface to be able to provide the interface to the standards compliant browser or client.

The invention claimed is:

1. A trailer electronic braking system, comprising:

a braking device capable of generating a braking force on a wheel on the trailer, a brake force into the brake cylin-

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ders being controllable by an electropneumatic braking pressure control module, wherein the electropneumatic braking pressure control module is connected to a standards compliant communication bus on the trailer and is adapted to receive data inputs from sensors on the trailer; and

an interface arrangement to interface trailer electronics and a communications interface, the communications interface having a wireless device configured to transmit a trailer identifier, which includes a service set identifier (SSID), for enabling pairing with a further device receiving the trailer identifier.

2. The trailer electronic braking system of claim 1, wherein the interface arrangement includes a microcontroller.

3. The trailer electronic braking system of claim 1, wherein the wireless card includes an 802.11 wireless card, which is adapted to transmit the SSID, the trailer identifier including the SSID.

4. The trailer electronic braking system of claim 1, wherein the trailer electronic braking system is provided with a list of MAC addresses associated with allowable further devices, and wherein the braking system detects the MAC address of any further devices it detects such that it only pairs with an allowable MAC address.

5. The trailer electronic braking system of claim 1, wherein the further device is provided with parking brake releases codes, which codes can be transmitted to the electropneumatic braking pressure control module after pairing to release the parking brake.

6. The trailer electronic braking system of claim 1, wherein the road train includes two or more trailers, at least two of which trailers are adapted to transmit the trailer identifier for each of the trailers, wherein a first trailer for connection to a tractor or prime mover is adapted to request or detect the trailer identifier of another trailer, wherein if the trailer identifier is associated with the road train, and wherein the first trailer instructs the second trailer to stop transmitting the trailer identifier of the second trailer.

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